WHAT IS CLAIMED IS

1. A method of extracting features for lighting-invariant face description, comprising the steps of:

getting adjusted second -order eigenfeatures of a face image;

quantizing said adjusted second-order eigenfeatures; and

selecting features to construct face descriptor to describe faces from the said quantized second –order eigenfeatures.

2. A method of extracting features for lighting-invariant face description, comprising the steps of:

getting adjusted second -order eigenfeatures of a face image;

quantizing said adjusted second-order eigenfeatures;

selecting features to construct face descriptor to describe faces from the said quantized second –order eigenfeatures; and

coding said selected eigenfeatures in the lighting-invariant face descriptor.

3. A method of extracting features for view-angle-invariant face description, comprising the steps of:

getting adjusted first –order eigenfeatures of a face image;

getting adjusted second -order eigenfeatures of a face image;

quantizing said adjusted first –order eigenfeatures;

quantizing said adjusted second -order eigenfeatures; and

selecting features to construct face descriptor to describe faces from said quantized first-order and second –order eigenfeatures.

4. A method of extracting features for view-angle-invariant face description, comprising the steps of:

getting adjusted first –order eigenfeatures;

getting adjusted second -order eigenfeatures;

quantizing said adjusted first –order eigenfeatures;

quantizing said adjusted second -order eigenfeatures;

selecting features to construct face descriptor to describe faces from said quantized first-order and second –order eigenfeatures; and

coding said selected eigenfeatures in the view-angle-invariant face descriptor.

5. A method in claim 1 of getting adjusted second-order eigenfeatures of a face image, comprising the step of:

getting the dot product of the face image and an adjusted second-order eigenface matrix.

6. A method in claim 3 of getting adjusted first-order eigenfeatures of a face image, comprising the step of:

getting the dot product of the face image and an adjusted first-order eigenface matrix.

7. A method of computing said adjusted first-order eigenface matrix in claim 6, comprising the steps of:

calculating a first –order eigenface matrix; and

adjusting said first–order eigenface matrix.

8. A method of computing said adjusted second-order eigenface matrix in claim 5, comprising the steps of:

calculating a second –order eigenface matrix; and

adjusting said second –order eigenface matrix.

9. A method in claim 7 of adjusting the said first-order eigenfaces, comprising the steps of:

getting the first-order eigenfeatures of the training face images;

arranging the first-order eigenface as a two dimensional array of the original images;

getting the mirrored eigenface of said two dimensional array;

weighting said mirrored eigenface image;

adding said weighted eigenface image to the said first-order eigenface;

re-arranging the first-order eigenface to obtain the one-dimensional adjusted first-order eigenface;

normalizing the adjusted first-order eigenfaces;

getting the weights of the adjusted first-order eigenfeatures for distance computation;

multiplying the weights of the first-order eigenfeatures for distance computation to the adjusted first-order eigenface matrix; and

quantizing the first-order eigenface matrix.

10. A method in claim 8 of calculating the second –order eigenfaces, comprising the steps of:

calculating a first-order eigenface matrix;

getting first-order eigenfeatures from the training face images;

calculating a pseudo-inverse of said first –order eigenface matrix;

calculating the first-order reconstructed face images by multiplying the said first-order eigenfeatures to the said pseudo-inverse of the first-order eigenface matrix;

getting second –order residue images by subtracting the first-order reconstructed face images from the original images; and

getting the second-order eigenfaces by calculating the eigenvectors of said second - order residue images.

11. A method in claim 8 of adjusting the second –order eigenfaces, comprising the steps of:

getting the second-order eigenfeatures of the training images by computing the dot products of the face images and the second-order eigenfaces;

re-shaping the second-order eigenfaces to the original image shape and getting the left-right mirrored eigenface images;

weighting the mirrored eigenface images and adding them to the corresponding original image shaped second-order eigenface images;

re-arranging the original image shaped second-order eigenfaces to obtain the one-dimensional adjusted second-order eigenfaces;

normalizing the adjusted second-order eigenfaces;

getting the weights of second-order eigenfeatures for distance computation;

multiplying the weights of second-order eigenfeatures for distance computation to the adjusted second-order eigenface matrix; and

quantizing the second-order eigenface matrix.

12. A method in claim 9 of quantizing the adjusted first-order eigenface matrix, comprising the steps of:

getting the maximum and the minimum of the adjusted first-order eigenface matrix;

getting the quantization step by dividing the interval between said maximum and said minimum into a plurality of quantization levels;

dividing said adjusted first-order eigenface matrix with said quantization step; and

rounding said divided values to the nearest integers.

13. A method in claim 11 of quantizing the adjusted second-order eigenface matrix, comprising the steps of:

getting the maximum and the minimum of said adjusted second-order eigenface matrix;

getting the quantization step by dividing the interval between said maximum and said minimum into a plurality of quantization levels;

dividing said adjusted second-order eigenface matrix with said quantization step; and

rounding said divided values to the nearest integers.

14. A method in claim 1 of getting the adjusted second-order eigenfeatures, comprising the steps of:

getting the recovered adjusted second-order eigenface by multiplying the said quantized second-

order eigenface matrix with the said quantization step in the claim 11; and

getting the second-order eigenfeatures by multiplying each column-wise recovered adjusted

second-order eigenface with the row-wise face image;

15. A method in claim 3 of getting the adjusted first-order eigenfeatures, comprising the steps of:

getting the recovered adjusted first-order eigenface by multiplying the said quantized first-

order eigenface matrix with the said quantization step in the claim 12; and

getting the first-order eigenfeatures by multiplying each column-wise recovered adjusted

first-order eigenface with the row-wise face image.

16. A method in claim 1 of quantizing the adjusted second-order eigenfeatures, comprising of the steps of:

getting the maximum and the minimum of said adjusted second-order eigenfeatures of the training images;

getting the quantization step by dividing the interval between said maximum and said minimum into a plurality of quantization levels;

dividing said adjusted second-order eigenfeatures with said quantization step; and

rounding said divided values to the nearest integers.

17. A method in claim 1 of quantizing the adjusted second-order eigenfeatures, comprising of the steps of:

getting the maximum and the minimum of said adjusted second-order eigenfeatures of the training images;

getting the quantization step by dividing the interval between said maximum and said minimum into a plurality of quantization levels;

dividing said adjusted second-order eigenfeatures with said quantization step;

rounding said divided values to the nearest integers;

allocating different number of bits to different eigenfeatures by computing the rounded logarithm of the standard deviation of the corresponding eigenfeatures in the training set divided by minimum of the standard deviations; and

quantizing said eigenfeatures according to the corresponding bit allocation.

18. A method in claim 3 of quantizing the adjusted first-order eigenfeatures, comprising of the steps of:

getting the maximum and the minimum of the adjusted first-order eigenfeatures of the training images;

getting the quantization step by dividing the interval between said maximum and said minimum into a plurality of quantization levels;

dividing said adjusted first-order eigenfeatures with said quantization step; and

rounding said divided values to the nearest integers;

19. A method in claim 3 of quantizing the adjusted first-order eigenfeatures, comprising of the steps of:

getting the maximum and the minimum of the adjusted first-order eigenfeatures of the training images;

getting the quantization step by dividing the interval between said maximum and said minimum into a plurality of quantization levels;

dividing said adjusted first-order eigenfeatures with said quantization step; rounding said divided values to the nearest integers;

allocating different number of bits to different eigenfeatures by computing the rounded logarithm of the standard deviation of the corresponding eigenfeatures in the training set divided by minimum of the standard deviations; and

quantizing said eigenfeatures according to the corresponding bit allocation.

20. A method in claim 9 of getting the weights of the adjusted first-order eigenfeatures for distance computation, comprising the steps of:

getting the standard deviations of said adjusted first-order eigenfeatures of the training face images; and

getting the weights by extracting the square roots of said standard deviations.

21. A method in claim 11 of getting the weights of the adjusted second-order eigenfeatures for distance computation, comprising the steps of:

getting the variances of said adjusted second-order eigenfeatures of the training face images; and

getting the weights of the adjusted second-order eigenfeatures by extracting the square roots of said variances.

22. A method of measuring lighting-invariant similarity between faces, comprising the steps of:

extracting the eigenfeatures of the faces for lighting-invariant face description with the method described in claims 1 and 2;

getting the Euclidean distances of said eigenfeatures of the faces; and

choosing the smallest Euclidean distance to indicate the best matching pair of faces.

23. A method of measuring view-angle-invariant similarity between faces, comprising the steps of:

extracting the eigenfeatures of the faces for view-angle-invariant face description with the method described in claims 3 and 4; and

getting the Euclidean distances of the features of the faces; and

choosing the smallest Euclidean distance to indicate the best matching pair of faces.

24. A method of getting code tables of variable length coding (VLC) for light-invariant face descriptor, comprising the steps of:

getting the said quantized eigenfeatures of the training set with the method described in claim 1;

classifying said eigenfeatures in to groups depending on the bit allocations;

constructing a code table for each of the said group of eigenfeatures with the same bit allocation, using an entropy coding method.

25. A method of getting code tables of variable length coding (VLC) for view-angle-invariant face descriptor, comprising the steps of:

getting the said quantized eigenfeatures of the training set with the method described in claim 3;

classifying said eigenfeatures in to groups depending on the bit allocations;

constructing a code table for each of the said group of eigenfeatures with the same bit allocation, using an entropy coding method.

26. A method of constructing a code table in claim 24 where the entropy coding method is a Huffman coding method based on the probability of the quantization level.

27 A method of constructing a code table in claim 24 where the entropy coding method is an Arithmetic coding method based on the probability of the quantization level.

28. A method in claim 1 of coding lighting-invariant face descriptor, comprising the step of:

looking up the code table generated with the method described in claim 24 for each quantized eigenfeature and using the corresponding code word to represent said quantized eigenfeature.

29 A method in claim 3 of coding view-angle-invariant face descriptor, comprising the step of:

looking up the code table generated with the method described in claim 25 for each quantized eigenfeature and using the corresponding code word to represent said quantized eigenfeature.

30. A method of extracting features for general face description, comprising the steps of:

getting adjusted first-order eigenfeatures of a face image with the method in the claim 7;

quantizing said adjusted first-order eigenfeatures with the method in the claim 19; and

selecting features to construct face descriptor to describe faces from the said quantized first-order eigenfeatures.

31. A method of extracting features for general face description, comprising the steps of:

getting adjusted first-order eigenfeatures of a face image with the method in the claim 7;

quantizing said adjusted first-order eigenfeatures with the method in the claim 19;

selecting features to construct face descriptor to describe faces from the said quantized first-order eigenfeatures; and

coding said selected eigenfeatures in the face descriptor.

32. A method in the claim 30 of selecting features to construct face descriptor to describe faces from the said quantized first-order eigenfeatures, comprising the step of:

The eigenfeatures corresponding to the top N largest eigenvalues are selected for view-angle invariant face description.

33. A method in the claim 30 of selecting features to construct face descriptor to describe faces from the said quantized first-order eigenfeatures, comprising the step of:

The eigenfeatures corresponding to the k-th to N-th largest eigenvalues (0<k<N) are selected for lighting-invariant face description.